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PAPERS

IN

CHEMISTRY.

No. I.

APPARATUS TO ENABLE PERSONS TO BREATHE IN THICK SMOKE, OR IN AIR LOADED WITH SUFFOCATING VAPOURS.

The LARGE SILVER MEDAL *and* FIFTY GUINEAS *were this session presented to Mr.* JOHN ROBERTS *of St. Helens, Lancashire, for his apparatus to enable persons to breathe in thick smoke or in air loaded with suffocating vapours. A set of the apparatus has been placed in the Society's Repository.*

THE subject was introduced to the notice of the Society, by a letter from Dr. Henry of Manchester, dated March 2, 1825, and addressed to the Secretary, of which the following is an extract:—

"This letter will be delivered to you by John Roberts, a poor collier, who has lately invented an apparatus for enabling persons to enter without injury apartments filled with smoke and suffocating vapours. Of the contrivance itself, and its mode of operation, it is unnecessary that I should say any thing to you; but it is proper to observe that he has freely and unreservedly disclosed his invention, and exhibited its use, and that he looks for his reward to such public bodies, as, after scrutinizing its merits, may be satisfied of its utility.

"At the request of the Manchester Assurance Company, I was present at an experiment made in a close stove at an iron foundry, of the capacity of about 1120 cubic feet. About twenty pounds of cotton waste, made rather moist so that it might undergo a smothered combustion, were set on fire, and the doors (sliding ones of iron as high as the stove) were then shut. In a few minutes Roberts went in, and not long afterwards was followed by another person, son of the proprietor of the foundry. The doors were closed, and drawn asunder occasionally to hand in different articles, or to ascertain the safety of the parties. At these times, a lower current of cold and fresh air rushed in, and an upper current of smoke and acrid vapour rushed out, of so suffocating a nature, that standing close to the door, and being each time enveloped in it, I was satisfied that the upper state of the atmosphere within the stove must have been completely unrespirable. Roberts and his companion remained in about twenty minutes, at which time I caused a bottle of quicksilver to be emptied within the stove, about the height of the nostrils from the ground. The air thus obtained had not sustained a loss of more than one per cent. oxygen, or gained more than one per cent. carbonic acid. The noxious state of the air within the stove was owing therefore to the smoke and vapour with which it was loaded, and not to loss of oxygen; but the suffocating effects of a small quantity of chlorine, diffused through a large quantity of air, prove that air may in this way be rendered as unrespirable as by abstracting its oxygen.

"Roberts is desirous to have his apparatus submitted in London to the test of experiment; and if this be done, I would beg leave to suggest that it will be well to ascertain whether he can enter an *up-stairs* apartment filled with smoke *from below*. In the experiment here, the stove was on the ground floor, and therefore very favourably situated for obtaining a renewal of fresh air near the ground, which appears quite essential to the security of his apparatus.

"I have suggested to him that a pane of mica, in front of the eyes, would not be so liable to be cracked by the contact of flame as glass; and that the spunge would be more effectual if wet with soap lees than with water."

The apparatus, see plate I., figs. 1. and 2., consists of a cap or hood of leather, with two orifices, filled up with strong glass or mica, to see through. The hood descends as low as the bottom of the neck, and is well wadded so as to be rendered air tight, or nearly so, when secured by the straps *b b b*. The wadding is carefully continued round the whole external edge of the nose, in order to prevent any air from passing thence to the eye-holes, and impeding the sight by depositing moisture on the inner surface of the glass. From the nose is continued a flexible leather pipe, *a a*, having a spiral wire inside to prevent it from being compressed. The pipe terminates in a trumpet-like piece of japanned tin plate *d d*, the open end of which is filled up with moist sponge, and covered externally by a piece of coarse woollen cloth. At *c c* is a strap and buckle to secure the pipe to the lower part of the thigh, that it may not incommode the wearer by dangling about his legs.

By this arrangement, all the air that is drawn in at each inspiration passes through the pores, first of the moist cloth and then of the moist sponge. The consequence is, that all particles floating in the air are separated from it mechanically, and at the same time all those vapours or gasses that are in any considerable degree absorbable by moisture are separated by chemical action. The result of both these conjoint actions is, that air, mingled with smoke or sulphurous acid vapour, is purified from these substances, and rendered respirable provided the oxygenous portion of the air has not been materially diminished.

The candidate stated to the committee, that the first thing which suggested to him the possibility of separating the respirable air from smoke and other vapours with which it may be charged, was the relief which he found from covering his lips and nostrils with the edge of his flannel shirt while descending the shaft of a coal pit to his daily occupation, in which shaft two fires were burning for the purpose of keeping up a current of air through the mine. He next tried the effects of wringing out a woollen jacket in water, and closely covering his face with it: the advantage was decided, both in excluding the smoke and also in cooling the air. He afterwards tried a wet sponge with similar good effect. The invention or adoption of the hood naturally followed in his endeavour to combine these advantages with the free use of his hands and eyes.

He had observed (as others also have done) that in rooms which are filled, as it is called, with smoke, the stratum of air near the floor is mixed with a smaller proportion of smoke than any other part, in confirmation of which it is well known that firemen and others, who are occasionally obliged to work in thick smoke, are able to remain in it much longer while on their hands and knees than when standing upright. Hence, in adapting his discovery to the use of firemen, he was led to annex a pipe to the head, descending as low as the middle of the thigh, in order to allow the wearer, while standing upright, to be drawing his supply of air from a less contaminated portion than that which enveloped the upper part of his body, while, at the same time, it should be no material embarrassment to him in a stooping posture.

The secretary and several members of the Society were invited to witness an experiment on the efficacy of Roberts's invention, which was made at the house of the Mechanics' Institution, 29, Southampton-buildings, on the 25th of March.

In the area of the lecture room, the walls alone of which were at that time finished, a chamber was constructed of boards about fifteen feet high. A short ladder was placed in it, so as to enable a person to reach the upper part, and two windows were inserted about four feet from the ground: a hearth of bricks supported the combustibles from which the smoke was to be obtained.

Moist wood shavings, wet hay, two pounds of brimstone, and a shovel full of rosin, were set fire to, and the door was shut. In a few minutes the chamber seemed full of smoke: on opening the door a quantity of smoke flowed out, and in a few minutes the lower part of the room, to the height of about 2½ feet, was clear, while a dense cloud filled all above. The smoke was intensely suffocating, and produced violent coughing on being inspired. The door being then shut the cloud of smoke descended nearly to the floor, so that some firemen, who had entered the chamber, were only enabled to remain there by crouching almost on their bellies.

These preliminary experiments being made, more fuel was put on the fire, and Roberts, with his apparatus on, entered the room, walking erect. The temperature of the room was at this time 68° *Fahr.*, that of the external air, being 48°. In ten minutes the temperature had risen to 87° in the upper part of the chamber. At 19 minutes the candle on the window-board, which had been burning very dim, went out; at 20 minutes the temperature was 91°, at 22 minutes it was 104°, at 30 minutes the candle fell down in a melting state, the temperature being 115°. At 36 minutes Roberts came out of the chamber, having been for the last quarter of an hour on the ladder in the upper part of the chamber, and quite invisible from the density of the smoke. When he came out he was, as might be expected, very hot, and his pulse was 174, but he did not appear exhausted: he took some coffee, and in about half an hour his pulse had subsided to its ordinary state.

The air, exclusive of the smoke and sulphurous acid floating in it, differed from common air only in containing two per cent. more of carbonic acid, and two per cent. of oxygen, thus showing that it is unfitted for respiration only by the smoke and vapours floating in it.

A second experiment was made on the 2d of April, with a perfectly similar and equally satisfactory result, in presence of several scientific persons, and of some of the managers or directors of fire offices. Of this experiment the following are the details, as stated in the *Mechanics' Register*, No. 24:—

"The fire having been previously prepared, and an ample supply of combustibles placed in the temporary room used on the former occasion, Roberts put on his apparatus, and entered the apartment at eight minutes after two o'clock, at which time the thermometer on the outside stood at 54°. About three pounds of sulphur, in addition to other combustibles, were consumed during the experiment, the sulphur being placed in an iron pan, to prevent it from escaping combustion by falling to the floor of the apartment. The density of the cloud of noxious smoke, and the heat of the room, increased as before, till the temperature indicated by the thermometers fixed in different places was as follows:—

At the ceiling.................	158
In the centre.................	101
Near the floor	68

One of the workmen entered the room upon his hands and knees during the experiment, but on attempting to raise his head higher than about a foot from the ground, the suffocating sensation compelled him to quit the chamber with precipitation, after remaining there only two or three minutes. Roberts, in the mean time, traversed the room in an erect posture, supplied the fire with additional combustibles, and occasionally ascended the ladder, without feeling any inconvenience, except from the heat; and after having been enveloped in the smoke exactly thirty-nine minutes, and afforded to every spectator a satisfactory demonstration of the efficacy of his invention, he quitted the apartment at thirteen minutes before three o'clock, and disencumbered himself of his apparatus in one of the lower rooms of the Institution. Mr. Pettigrew here examined his pulse, which was at 160, but subsided to 114 in about twenty minutes, and soon afterwards resumed its ordinary motion."

No. II.

IMPROVED MELTING POTS.

The Silver Vulcan Medal and Twenty Guineas were this session presented to Mr. L. Anstey, of Drummond-crescent, Somers-town, for his Improved Melting Pots for Iron and Brass Founders. Samples of the Pots are in the Society's Repository.

27, Drummond Crescent,
17th March, 1825.

Sir,

I herewith send a melting-pot of my manufacture, which, from several years' experience in the melting of cast-iron, I find to answer the purpose better than any which I have been enabled to procure. They are composed of two parts Stourbridge clay, and one part of the hardest coke, well ground and tempered together. Any further explanation I should be happy to give, if required.

I am, Sir,
&c. &c. &c.
L. Anstey.

A. Aikin, Esq.
Secretary, &c. &c.